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ABSTRACT

Measurement of student achievement is an integral part of the teaching-learning process in Health Occupations Education and is essential for effective guidance of student growth. The measurement devices used in classroom and clinical site instruction should be directed toward stated behavioral objectives, providing valid and reliable evidence of student growth. This evidence also can be used to determine readiness for learning new skills and knowledge, to pinpoint areas for remedial work, and to provide guidance for improving instruction. Many New York State Health Occupations Education teachers have experienced difficulty in developing good classroom and clinical tests and other instruments for assessing student progress, and have expressed a need for assistance. Therefore, this publication was prepared to provide guidelines in the construction of a variety of measurement devices and effective ways to use these educational instruments. (Author/MV)

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MEASURING STUDENT ACHIEVEMENT

in

HEALTH OCCUPATIONS EDUCATION

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FOREWORD

Measurement of student achievement is an integral part of the teaching-learning process in Health Occupations Education and is essential for effective guidance of student growth. The measurement devices used in classroom and clinical site instruction should be directed toward stated behavioral objectives, providing valid and reliable evidence of student growth. This evidence also can be used to determine readiness for learning new skills and knowledge, to pinpoint areas for remedial work, and to provide guidance for improving instruction.

Many Health Occupations Education teachers have experienced difficulty in developing good classroom and clinical tests and other instruments for assessing student progress, and have expressed a need for assistance. Therefore, this publication was prepared to provide guidelines in the construction of a variety of measurement devices and effective ways to use these educational instruments.

The development of this publication was completed under the direction of Ruth-Ellen Ostler, Chief of the Bureau of Health Occupations Education. Assistance relating to content was provided by Ina E. Conley, Associate in the Bureau of Health Occupations Education. The manuscript was prepared and coordinated by Diane Reiner, Consultant, and Kenneth Ormiston, Associate in the Bureau of Elementary and Secondary Educational Testing.

Winsor A. Lott, Chief
Bureau of Elementary and
Secondary Educational Testing

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I. THE ROLE OF MEASUREMENT IN THE INSTRUCTIONAL PROCESS

A. Why Measure?

There is a growing concern for accountability in education. Those who support our educational enterprises want to know how well the job is being done. The questions that are being raised cannot be answered without the information obtained through measurement.

This publication is intended for teachers and deals with measurement in the classroom and the clinical-experience site. A few reasons why measurement is important are listed below.

1. To Plan Instruction. If skills and knowledge needed for the job are identified and if prior achievement of the student is measured before instruction, instruction can be tailored to meet the needs of the student and the job market. In addition, the student will better understand the specific objectives for instruction.

2. To Motivate Students. Most students will exert a greater effort to learn when they know that their achievement will be measured from time to time and that they will participate in this measurement.

3. To Evaluate Instruction. The extent to which students attain an objective is an indication of the effectiveness of instruction and the degree of student competence achieved.

4. To Assign Grades. Perhaps the most obvious reason for measuring achievement is to assign grades that represent a fair and accurate measure of student growth.

5. To Continuously Revise and Update Curriculum. Measurement of the degree to which the performance of graduates actually meets expectations of employers is crucial to realistic program revision.

B. What to Measure

The main goal of the measurement process is to determine the extent to which students have attained the desired objectives. Each segment of the minimum course content contained in the State syllabuses for the various Health Occupations Education programs includes "instructional objectives" stated in terms of desired student performance. Two styles of objectives are used in each syllabus:

1. "*The student should be able to.*" defines the skills and knowledge that the student should be able to demonstrate after instruction, that are considered necessary to entry-level proficiency.
2. "*The student should be.*" sets forth instruction in areas that are good to know or helpful in achieving student understandings. Objectives in the affective domain of student attitudes are also written in this style because of the subjective nature of teacher evaluation of this student performance.

Each locally developed Health Occupations Education program course of study is expected to include similar performance objectives, rewritten in more detail to specifically define the skills and knowledge necessary for employment in the field under study.

These objectives describe a variety of behaviors, but all of them can be included under one of three headings or domains—cognitive, psychomotor, and affective. A brief explanation of each of these three categories of behaviors follows:

Behaviors within the cognitive domain ". . . deal with the recall or recognition of knowledge and the development of intellectual abilities and skills."[1] The knowledge objectives relate to the psychological processes of remembering, whereas the intellectual abilities and skills objectives relate to the mental processes of organizing and reorganizing material to achieve a particular purpose.

Behaviors within the psychomotor domain include manipulative skills. Behaviors within the affective domain involve ". . . changes in interest, attitudes, and values, and the development of appreciations and adequate adjustment."[2]

Following are a few examples of the kinds of objectives that would be included in each of the three domains.

[1] Bloom, B. S., ed., *Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain*. New York: McKay, 1956, p. 7.

[2] Ibid.

1. **Cognitive Domain:**
   - Knows the structure and function of the body systems.
   - Identifies the four factors composing vital signs.
   - Names and defines the various types of microorganisms.
   - Recognizes behavior patterns that indicate emotional problems.

2. **Psychomotor Domain:**
   - Is able to complete a variety of standard reporting and recording forms.
   - Demonstrates an accepted method of taking vital signs.
   - Is able to set up equipment for any standard diagnostic test.
   - Is able to prepare a patient for minor surgery.

3. **Affective Domain:**
   - Shows interest in preparing self for career.
   - Is aware of the importance of safety consciousness.
   - Demonstrates a commitment to good interpersonal relationships with coworkers.
   - Demonstrates an empathy for the mental and emotional stresses of the patient to be examined.

All three types of objectives are important, and the teacher should attempt to measure the extent to which all students have achieved in each domain. The teacher must be aware, however, that the techniques used to measure achievement for each of the three domains differ greatly.

C. How to Measure

Different types of instruments can be used to obtain information about student achievement. Paper and pencil tests with objective (multiple-choice, completion, true-false, matching) and essay questions, performance tests, questionnaires, inventories, logs, diaries, and anecdotal records can all provide valuable information.

When measuring pupil progress to assign grades, only the cognitive and psychomotor objectives should be measured, since it is difficult to obtain a reliable measure of student achievement of the affective objectives. What is most often measured for affective objectives is the students' knowledge of the attitudes that are considered acceptable, not the students' actual attitudes. This is especially true if the students know that the test results will be used to assign grades. Also, when measuring the affective objectives it is often impossi-

ble to construct test questions that have a single correct answer. Each question may have several correct answers, depending on the students' values. Students should not be penalized if they express interests, attitudes, or values that are different from those of the teacher. Only paper and pencil tests using objective and essay questions and performance tests should be used to measure achievement of the cognitive and psychomotor objectives. The second section of this booklet contains suggestions for preparing these types of instruments.

Additional reasons for measuring achievement are to plan instruction and to judge the effectiveness of instruction as well as to help students to see their progress. The third section of the booklet will contain suggestions for preparing instruments that can be used for these purposes.

Following is a table that shows which types of instruments may be used by the teacher to assign grades and to plan and evaluate instruction for each of the three domains.

Table 1

Selection and Use of Instruments

Behavioral Objectives	Instruments that can be used to assign grades	Instruments that can be used to evaluate and plan instruction
Cognitive Domain (knowledge and intellectual abilities and skills)	Paper and pencil tests using objective and essay questions	Paper and pencil tests using objective and essay questions
Psychomotor Domain (manipulative skills)	Performance tests (scored by teacher only)	Performance tests (scored by teacher, other students, or students themselves)
Affective Domain (attitudes, values, and interests)	None	Questionnaires, inventories, logs, diaries, and anecdotal records

II. PREPARING INSTRUMENTS USED TO ASSIGN STUDENT GRADES

A. Preparing a Test Blueprint

The first step in preparing any test instrument is to prepare a test blueprint. In preparing the blueprint, the teacher must decide what cognitive and psychomotor objectives are to be measured by the test and what their relative weights should be. These factors must be considered if the teacher is to construct a test that will provide a valid picture of pupil progress.

There is no single type of blueprint that is best for all tests. For a brief quiz, a listing of objectives and their relative weights is sufficient. A semester or final examination, however, requires a much more comprehensive blueprint.

One sample blueprint for a semester test in Health Occupations Education is presented in table 2. The major steps followed in constructing this blueprint are listed below:

1) Vertical listing of the behavioral objectives to be included in the test and the amount of instructional time (in hours) that was required for each.
2) Determination of the percentage of the total test that should be allocated to each objective (last column). Each percentage is determined by dividing the instructional time required for each objective by the total instructional time.
3) Division of the percentage allocated to each objective (as obtained in step 2) into cognitive and psychomotor objective percentages.

It should be noted that the weighting (step 3) between the cognitive and psychomotor columns would probably vary from teacher to teacher and even from class to class. The main considerations that would affect this weighting are the stated objectives of each unit and the teacher's judgment as to which objectives are most important.

When the test blueprint has been completed, the teacher must then decide which objectives are to be measured for each unit included in the blueprint. In a semester test, the teacher cannot always measure student progress toward all objectives for all the units included in the blueprint. Therefore, the teacher must select those cognitive and/or psychomotor objectives that he or she believes to be most important.

Table 2

TEST BLUEPRINT FOR A SEMESTER TEST IN DENTAL ASSISTING

Unit titles	Behavioral Objectives	Instructional time, in hours*	Percentage of total test allocated to each objective		
			Cognitive	Psychomotor	Total
1. General Orientation	a. Analyzes the various levels of the dental health team by describing educational requirements, duties, and responsibilities, and certification or licensing requirements.	10	6	—	6
	b. Differentiates among the various aspects of the dental assistant's duties and responsibilities.	10	6	—	6
2. Dental Terminology	a. Spells and pronounces all common dental terms.	3	3	—	3
	b. Defines and properly uses all terms commonly used in the field of dentistry.	8	4	—	4
	c. Demonstrates an ability to convert dental terminology to lay terms.	7	4	—	4
3. Oral Anatomy	a. Identifies each tooth by name and describes the particular function of each.*	9	5	—	5
	b. Labels all parts of the tooth and describes the function of each part.	8	4	—	4
	c. Identifies, by name and location, each surface of the tooth and writes the standard abbreviations.	8	4	—	4
	d. Lists the average eruption dates of the teeth.	8	4	—	4
	e. Identifies by name and location each of the facial bones and describes their functions.	9	5	—	5
	f. Identifies by name and location each of the muscles of mastication and describes their functions.	9	5	—	5

		g. Identifies by name and location each of the salivary glands and describes their functions.	9	5	—	5
4.	Dental Instruments and Equipment	a. Identifies by name a broad variety of dental instruments.	8	4	—	4
		b. Describes the use and function of specified dental instruments.	9	5	—	5
		c. Demonstrates proper care and maintenance of all dental instruments and equipment.	7	2	2	4
		d. Demonstrates conformity to all safety rules, regulations, and procedures.	6	—	3	3
5.	Chairside Assisting	a. Makes all adjustments in chair mechanisms necessary to position the patient for work to be done.	3	—	2	2
		b. Seats the patient comfortably in either a conventional or a contour chair.	3	—	2	2
		c. Drapes the patient with the degree of protective covering needed for the procedure to be performed.	3	—	2	2
		d. Prepares dental instrument setups in order of use for standard dental procedures.	10	3	3	6
		e. Demonstrates smooth passing of various dental instruments to and from the operator's hand.	6	—	3	3
6.	Office Management	a. Demonstrates approved methods of using the telephone.	3	—	2	2
		b. Lists the items of information that should be elicited from callers.	4	2	—	2
		c. Demonstrates an ability to efficiently maintain any standard filing system.	9	3	2	5
		d. Demonstrates an ability to maintain an efficient inventory-control system.	9	3	2	5
		Totals:	**180 hrs.**	**77%**	**23%**	**100%**

* **Based on 200 instructional hours per semester. Affective objectives requiring 20 hours of instructional time are not included in this test blueprint since these cannot effectively be measured by an objective-type test.**

B. Choosing an Item Type

After the blueprint has been prepared, the next step is to select the type of test items that will most effectively measure student progress toward each behavioral objective. The teacher should always be sure that the test item chosen actually measures the same type of behavior as is described by the objective. Many times a teacher will construct a test item that does not measure the behavior described by the objective. An example is given below:

Objective	The student uses all the safety and sanitary procedures demonstrated in class when stripping a hospital bed.
Poor test item	List all the safety and sanitary procedures demonstrated in class that should be followed when stripping a hospital bed.

The objective above states that the student should be able to use all the safety and sanitary procedures demonstrated in class when stripping a hospital bed, and is a psychomotor objective. However, the test item asks the student only to list the appropriate safety and sanitary procedures but not actually use them while stripping the bed. A more appropriate test item for the objective above is as follows:

Improved test item	Using the materials provided, and all of the safety and sanitary procedures demonstrated in class, completely strip a hospital bed.

The types of test items most commonly used when measuring student achievement of the cognitive objectives are essay questions, completion items, true-false items, multiple-choice items, and matching items; when student achievement of psychomotor objectives are being measured, performance tests are used.

A brief discussion of the advantages and disadvantages of each type of item used to measure achievement of the cognitive objectives follows. The construction of each type is described in part C, and the construction of performance tests is described in part D of this section.

1. Essay Questions

The fundamental contribution of the essay question is that it requires students to develop an answer from their own background or

experience, without the benefit of suggested possibilities or alternatives, and to express that answer in their own words. When the teacher wishes to test these skills, essay questions rather than objective questions should be used. By requiring students to present evidence, to evaluate, to analyze, and to solve new problems or approach problems in a new way, essay questions can serve to measure some higher level abilities and thus contribute to knowledge about the students.

The primary difficulty in the use of essay questions is achieving reliability of test scores. One source of unreliability in the essay question is subjectivity of rating. Considerable variation of assigned marks has been found, not only between one teacher and another, but in ratings by the same teacher from day to day. Usually, extreme cases of subjectivity of rating can be ascribed to failure to use a proper key or use of improper rating procedures, but the point remains that the rating of essay answers is inherently a matter of subjective judgment.

A second source of unreliability is possible inadequacy of sampling. When a test includes relatively few essay questions, the sampling of content in the test is likely to be quite narrow. A student who is strong in one area and weak in another will receive a high score if the test happens to include an essay in the first area and a low score if it happens to include, instead, an essay in the second area.

This does not mean that the teacher should avoid the use of essay questions. It does mean, however, that when essay questions are used, special care should be taken to achieve reasonable reliability of test scores. In addition, it would seem advisable for the teacher to reserve the use of essay questions for measuring outcomes that objective items are not believed to measure satisfactorily.

2. Completion Items

The completion item combines the recall skills needed to answer the essay question with the objectivity of rating achieved by a true-false or multiple-choice item. If completion items are well constructed, the answers are definite and specific, and the rating can be done quickly and accurately. Wide sampling of content is possible, since a relatively large number of items can be answered in a short period of time.

The main disadvantage of completion items is that it is very difficult to construct items measuring the higher levels of intellectual skills so that the items have only one correct answer. Teachers are

often surprised by the variety of correct answers given by students for an item that the teacher thought had only one correct answer. As the number of possible responses to an item increases, scoring becomes more difficult and more time consuming, and the obtained test scores become less reliable.

Practically speaking, only simple computations and verbal associations can be tested satisfactorily by completion items, and the search for such questions too often leads the teacher to concentrate on details. Examples of completion items are given below.

- An invoice for medical supplies dated May 10 lists the price as $80.00, less a discount of 10 percent. The terms were 1/10, n/30. If the invoice is paid on May 19, the amount paid should be _____.
- The part of the brain that controls speech, memory, intelligence, and skilled movements is the _____.

3. True-False Items

The true-false item is the easiest type of item to prepare. True-false items provide a good measure of the degree to which students have learned basic factual material. A wide range of subject matter can be tested by true-false items in a short period of time. They can be quickly and easily scored and scoring reliability is high.

However, true-false items tend to be less discriminating than multiple-choice items and somewhat more subject to ambiguity and misunderstanding. True-false items emphasize recognition over recall and application, and may encourage students to develop poor study habits such as rote memorization. True-false items must be based on material that is absolutely true or false and cannot be used to test knowledge of controversial or qualified material. Also it has been determined that for a true-false test to be as reliable as a multiple-choice test, it must contain almost twice as many items. An example of a true-false item is given below.

T F The leukocytes that destroy germs are called reticulocytes.

4. Multiple-Choice Items

Compared to other item types, a well-constructed, multiple-choice test item has a relatively high ability to discriminate between the students who have and who have not attained the course objectives.

A large range of subject matter can be tested by multiple-choice items in a short period of time. Multiple-choice tests can be used to measure all levels of knowledge and some intellectual skills. They can be quickly and easily scored, and scoring reliability is high.

However, it is often difficult to construct good multiple-choice items, and finding plausible alternatives is sometimes difficult. Multiple-choice items are often difficult for slow readers. An example of a multiple-choice test item is given below.

Which instrument should be used to enlarge a root canal?

1) broach
2) file
3) reamer
4) bur

5. Matching Items

The matching item requires relatively little reading time on the part of the students, as compared with other types of items, and a large number of questions can be answered in a short period of time. Scoring is simple and objective.

Unfortunately, it is often difficult to obtain a sufficient amount of related material so that homogeneous lists of premises and responses can be constructed. Furthermore, when the questions and answers can be no more than a word or phrase, they usually tend to be somewhat superficial. It is also difficult to eliminate all clues to answers in matching questions. An example of a matching question is given below.

On the line at the left of *each* type of vitamin listed in parts *a* through *e*, write the *number* of the deficiency symptom, *chosen from the list below*, that will occur if there is an insufficient amount of that vitamin in a person's diet.

Deficiency Symptoms

1) reduction in the number of red blood cells
2) poor digestion (beriberi)
3) nightblindness
4) tendency to bruise easily (scurvy)
5) soft bones (rickets)
6) improper blood clotting
7) mental disorders (pellagra)

—— *a* vitamin A
—— *b* vitamin B_{12}
—— *c* vitamin C
—— *d* vitamin D
—— *e* vitamin K

C. Measuring Achievement to Assign Grades: Cognitive Domain

When constructing test items for the cognitive objectives, the teacher should always remember that a good test item gives the students every possible opportunity to show what they have achieved. A test item will not measure well if it becomes a contest between the test constructor and the test taker, in which one wins and the other loses. A test item is a poor one if it tricks students into giving the wrong answers even though they really know the right answers.

Every test item should be written as clearly, directly, and simply as possible, so that all students understand what is expected of them. The more precisely the test item has been written, the more effectively it will perform the job expected. A difficult test item is not necessarily better than an easy test item if its difficulty is a result of inappropriateness, high vocabulary level, or a confusing presentation.

It is essential that the test constructor differentiate clearly between the acceptability of the concept being tested and the acceptability of the way in which the test item is presented to students. Following are a number of rules that should be followed by the teacher when preparing essay questions, completion items, true-false items, multiple-choice items, and matching items.

1. Essay Questions

a. Use the essay question to measure objectives that cannot be measured as well with other question types.

One of the common weaknesses in classroom tests is a failure to restrict the essay question to its special purposes, which results in the less efficient testing of objectives that could be better tested in other ways. The essay question should not be used solely to elicit information. The routine testing of the recall of information is a function that can be performed more effectively by objective-type questions. Consider, for example, the following question:

(Poor)

> Name 5 health workers, and list one duty that each worker performs.

This question does not call for analysis, judgment, problem-solving, or any of the abilities toward the measurement of which the essay question can make a special contribution. It affords little opportunity for written expression. Use of the essay form in this in-

stance serves merely to increase rating time, invite rating problems, and make the test scores less meaningful.

In contrast, the following type of question can be defended as having a special contribution that justifies the essay approach:

(Improved)

> In today's society, women are better accepted in the job market than they were in the 1920's. State whether you agree or disagree with this comment, and give three reasons to support your opinion.

From their background of knowledge and experience, the students must select the pertinent information, evaluate it, decide how best to express it, and write the answer. The mental processes the students go through would appear to be basically different from those that the students would use in answering related questions presented in the objective form.

b. Present the students with a clear-cut question that has only one interpretation and correct answer.

Too often, an essay question will ask students to write all they know about a certain topic. A question of this type can have as many different interpretations and correct answers as there are students. Thus, it becomes very difficult to determine the relative achievement of students on the topic covered by the test item. An essay question of this type is given below.

(Poor)

> Explain the function of different parts of the heart.

In order to allow comparison of students' achievement in a certain area, the essay question must be constructed so that it can be interpreted in only one way and has only one, specific answer. The question below is much more specific than the first example, and there should be a specific correct answer for each part.

(Improved)

> Describe the structure and function of each part of the heart listed below: (10)
>
> (a) aorta
> (b) pericardium
> (c) auricle
> (d) ventricle
> (e) septum

A helpful procedure for the teacher to follow is to outline be-

forehand all the possible answers that students may write in answer to an essay question. Sometimes it becomes immediately apparent that the question is too broad and general and that the scope of the question must be limited. Sometimes the reverse is found to be the case—that there is really not very much the student can give in answer to the question as framed. In such instances, the scope of the question can be broadened appropriately.

c. Use many brief essays rather than one or two extended essays.

There are two important reasons for using brief essays rather than long essays. First, a test composed of many brief essays will permit a wider sampling of the content of the course and will provide a more accurate picture of students' total achievement. Second, the test score will be more reliable. If the essay test contains only a few questions, each calling for a long answer, the students who happen to misinterpret one question will be penalized disproportionately to their real knowledge of the subject. To be reliable, a test must provide for a reasonable number of independent responses. A long essay may be carefully delimited in scope by subdivision into component elements, but these elements are generally too closely related to provide either the breadth of sampling or the higher reliability that can be obtained with an equivalent number of independent brief essays.

d. Indicate clearly in each question the type and length of the answer expected.

In each essay question, the teacher should indicate the type of answer expected by using keywords such as "explain," "describe," "outline," "list," "state," etc. The teacher should also indicate how many parts the answer should have and approximately how long each part of the answer should be. This can be done by providing either the approximate number of words required or the number of credits allocated for each part of the question. Providing this information will help to insure that the students will spend the appropriate amount of time on each question. Consider, for example, the question below.

Proper diet is important to good dental health.

(a) Name the *four* food groups and describe the nutrients that each provides. (8)

(b) List *two* foods which, when masticated, clean the teeth and stimulate the gums. (2)

In the question above, the students are told what type of answers

are expected by the words "name" and "describe" in part a and "list" in part b. The students are also told that the teacher expects eight different answers for part a and two different answers for part b. The number of credits allocated to each part should indicate that each answer can be fairly short. After reading this question, the students should have a clear idea of exactly what must be done and how long should be spent doing it.

2. Completion Items

a. Avoid using ambiguous statements that do not limit the answer to one or two specific words or phrases.

Each completion item should be examined carefully to make sure that it calls for a specific, limited answer. Too often the completion item is so ambiguous that it offers ample opportunity for the students to misinterpret the question or evade it. For example:

(Poor)

Ptyalin is an enzyme that _____.

The teacher should not be surprised to find several different answers such as "is in the mouth," "is mixed with saliva," "converts starch," or "begins digestion." Drawing the line between what does and what does not constitute a correct answer can be a difficult problem. Rewording the item as shown limits the correct answer to one specific word.

(Improved)

The part of the body in which the enzyme ptyalin begins to digest food is the _____.

b. Do not require more than one completion to be made in an item.

Sometimes completion items are constructed so that two or more blanks are left in the same sentence or paragraph. As the number of blanks increases, the interrelationships and combinations become more complex. Such questions frequently require an excessive amount of time to answer, require careful scoring for part-credit allowance, and introduce the extraneous factor of verbal facility into the measurement picture. In the following item, for example, too many words have been removed, and the item does not pose a clear-cut question.

(Poor)

Most [*communicable*] diseases are caused by [*germs*] that enter the body through the [*nose*] and [*mouth*].

c. The blank should be placed near or at the end of the statement.

If the blank to be filled in by the students comes at the beginning of the statement, the students must begin with a blank, read the statement, and then retrace their steps to decide what should be written in the blank. For example:

(Poor)

———— is the condition produced by a deficiency of vitamin D in the diet.

The item can be understood more readily by the students if the blank is at the end of the sentence. By the time the students reach the blank space, they should have all the information they need to answer the question. An "improved" version of the preceding item is given below.

(Improved)

The condition produced by a deficiency of vitamin D in the diet is called ————————.

d. Avoid extraneous clues to the correct answer.

Sometimes the grammatical structure of a completion item provides a clue to the correct answer. For example:

(Poor)

In a young child, hyperactivity is usually a symptom of an ———— maladjustment.

The use of the word "an" in this item would indicate to alert students that the correct answer must begin with a vowel. This would automatically eliminate such choices as "social," "physical," and "mental" simply because they begin with consonants.

The verb of a completion item can also provide a clue to the correct answer. An example of this type of clue is given below.

(Poor)

———— are a leading cause of death in young children.

The use of the verb "are" directly after the blank space automatically eliminates such possible answers as pneumonia or tuberculosis. In the "improved" version below, the verb of the item is placed before the blank space and does not provide a clue to the correct answer.

(Improved)

A leading cause of death in young children is ————————.

Another type of extraneous clue is the use of short blanks for short words and long blanks for long words. The length of the blank should not indicate the length of the word or phrase to be inserted. Nor should the number of blanks indicate the number of words omitted. In the following example, students are not likely to give the answers "chisel," "hatchet," or "scaler," since two blanks are provided for the answer.

(Poor)

An instrument used to remove decay in teeth is the _____ _____.

While the teacher does not want to discourage alertness in students, the main objective of any achievement test is to measure subject matter knowledge, not testwiseness. The presence of extraneous clues to the correct answer does not further this objective.

3. True-False Items

a. True-false items should always be based on statements that are absolutely true or false, without qualifications or exceptions.

Exceptions to true-false items can cause students to become confused if they are aware of the exceptions. This confusion is due to the fact that the students are not sure of the strictness of the standards of truth that must be applied. The following item is generally true and will be accepted by most students at the superficial level at which it is intended.

(Poor)

T F Bacteria need moisture to live.

Some superior students, however, might think that this is an item designed to test whether they realize that when bacteria form spores, they do not need moisture to live. On the basis of this exception, the students might mark the item false. Each true-false item should be reviewed carefully in an attempt to determine if there are any possible exceptions that could cause confusion in the minds of the students.

b. Avoid the use of long and involved statements.

Often a test item will contain information that is not essential to answering the item, but that makes it more interesting to the students or more realistic. The addition of nonessential information to an item tends to make the item so long and involved that the stu-

dents find it difficult to identify the crucial element in the item. For example:

(Poor)

T F Before an examination, the doctor instructs a nurse's aide to place a male patient in a lateral position. The patient should be positioned on the back with legs down.

When constructing items, the teacher should always try to make the items as short and easy to read as possible. In doing this, the teacher will ensure that the items are mainly measuring the students' knowledge of required concepts and not their ability to read. An "improved" version of the preceding item is given below.

(Improved)

T F When a patient is in a lateral position for an examination, the patient should be lying on the back with the legs down.

c. Avoid negative items whenever possible.

Negative items tend to create confusion by requiring a radical shift in orientation from previous questions. They reduce the test reliability by inducing careless errors due to overlooking the negative. To ask students to conclude that a negative item is false because it is not true that something is not true, involves a twist in reasoning that can be extremely confusing.

Usually the instructional objective of the teacher can be achieved just as well, and measured much more effectively, by the direct approach. Consider, for example, the following item:

(Poor)

T F Calcium is *not* essential for the growth of bones and teeth.

This concept can be tested more directly in a positive statement.

(Improved)

T F Calcium is essential for the growth of bones and teeth.

Items containing double negatives are especially likely to be troublesome.

(Poor)

T F A patient with hardening of the arteries should not be given a diet that does not contain low-saturated fats.

Again, the same concept can easily be tested in a positive form.

(Improved)

T F A patient with hardening of the arteries should be given a diet that contains low-saturated fats.

The only instance in which a negative item might be used is when the concept to be tested is essentially a negative one. In the example below, the concept being tested is normally presented to students in terms of what should not be done rather than what should be done.

T F Epenephrine is a local anesthetic that should *not* be given to patients with a cardiac disturbance or diabetes.

In such cases it is desirable to emphasize the negative nature of the item by underlining the negative words or by using distinctive type styles.

d. Avoid extraneous clues in the form of specific determiners.

An analysis of the usual true-false examination will reveal that the students who arbitrarily go through the examination and place a "false" next to every item containing an extreme word (such as *always*, *never*, and *all*) and a "true" next to every item containing a qualifying word (such as *usually*, *sometimes*, and *may*) will be right more often than they will be wrong. These words are used frequently by teachers because they are necessary to make the items foolproof—either absolutely true or absolutely false. Students soon begin to base their answer on these keywords rather than on the item as a whole. Examples of items with such extraneous clues are given below.

T F When moving a patient in a wheelchair, a nursing assistant should *always* push the wheelchair from behind.

T F Malnutrition *never* occurs in families that have enough money to spend for food.

T F Dental caries are *usually* produced by diets that contain an excessive amount of carbohydrates.

This does not mean that qualifying words should never be used in true-false items. It is not possible or desirable to avoid them completely. What should be avoided is the pattern of having certain types of words associated with certain answers. If items containing *always* or *usually* are sometimes true and sometimes false, the students are not provided extraneous clues to the correct answers.

4. Multiple-Choice Items

a. Each item should be based on a single central problem, which is completely stated in the stem of the item.

The item should be worded so that the students will know exactly what is being asked before reading the choices. In the following example, there is nothing in the stem to indicate to the students what the problem is. Just what does the teacher want to know about vitamin C? That can only be determined by reading all of the choices.

(Poor)

Vitamin C is

1) found in meat, eggs and fish
2) necessary to prevent scurvy
3) essential for normal vision
4) soluble in oil

The example above is actually concerned with four different problems: the source of vitamin C, the disease caused by a lack of vitamin C, the function of vitamin C in the body, and the solubility characteristic of vitamin C.

The students are not required to choose the best of a number of choices to a single problem, but rather to decide which of a number of independent true-false statements is more true than the others. This is a difficult and confusing task at best.

The best way to avoid this pitfall is to write the item first as a question rather than as an incomplete statement. If the stem of an item cannot be written in the form of a question, then the stem does not contain a completely stated central problem. After the question has been written and the four choices supplied, the question can be rewritten as an incomplete statement if so desired.

The foregoing example can be improved by basing the question on just one problem, as shown below. In this item, the students should know exactly what is being asked before reading any of the choices. If the teacher wishes to test the other three topics, separate questions should be written on each topic.

(Improved)

Which deficiency disease is prevented by an adequate supply of vitamin C?

1) beriberi
2) scurvy
3) pellagra
4) rickets

b. Each item should be written as clearly and simply as possible.

The ability of an item to indicate which students have obtained an

objective and which have not can be seriously limited when the item is not perfectly clear. The difficulty of an item should stem from the problem involved rather than the manner in which it is presented. In the example below, confusion could be caused by the unnecessary use of the words "terminology" and "most suitably," and by the manner in which the item is worded.

Through rewording and use of simpler vocabulary, the item can be made much clearer, as the "improved" version shows.

(Poor)

Which terminology would most suitably be used for those chemical substances which one microorganism produces which inhibit the growth of other microorganisms?

1) antibiotics
2) antiseptics
3) antitoxins
4) antidotes

(Improved)

The chemical substances which a microorganism produces that inhibit the growth of other microorganisms are called

1) antibiotics
2) antiseptics
3) antitoxins
4) antidotes

Another common way in which items are made unnecessarily difficult is by presenting too much material in one sentence, as is shown in the example below. In the "improved" version, the item is divided into two sentences and is much easier to read.

(Poor)

If the dental assistants do not like to stay late when a dentist has a very heavy workload and expects his dental assistants to work overtime every day, what should they do?

1) leave at the hour that has been specified as quitting time
2) come in later in the morning to compensate for overtime
3) talk to the dentist and try to come to some understanding
4) take a longer lunch hour to compensate for time spent working overtime

(Improved)

A dentist has a very heavy workload and expects his dental assistants to work overtime every day. If the dental assistants do not like to stay late, they should

1) leave at the hour that has been specified as quitting time
2) come in later in the morning to compensate for overtime
3) talk to the dentist and try to come to some understanding
4) take a longer lunch hour to compensate for time spent working overtime

c. Make all the choices plausible and attractive to students who lack the information or ability tested by the question.

As far as possible, each choice should be designed specifically to attract students who have certain misconceptions or who tend to make common errors. In the example below, choices 3 and 4 are implausible. Most students would probably consider only choices 1 and 2 and would have a 50-percent chance of selecting the correct answer, even if they did not know the concept being tested by the question.

(Poor)

How much time should be allowed for mixing silicate cements?

1) 1 min.
2) 2 min.
3) a long time
4) not very long

In the "improved" version, all choices are plausible and the students would have to know something about the concept being tested in order to eliminate any of the choices.

(Improved)

How much time should be allowed for mixing silicate cements?

1) 1 min.
2) 2 min.
3) 3 min.
4) 4 min.

d. Each item should have one and only one correct answer.

While this requirement seems obvious, it is not always fulfilled. In the example below, choice 4 was keyed as the correct answer. But examination of the other choices reveals that choices 2 and 3 are also correct.

(Poor)

One important function of the kidneys is to

1) keep the mineral content of the blood at a high level
2) control the composition of blood
3) excrete the end products of metabolism
4) regulate the amount of water in the body

This problem occurs mainly when the item writer fails to consider the full implications of each choice.

e. Avoid negative questions if possible.

Negative statements lead to the same difficulties and confusions in multiple-choice items as in true-false items. In the case of multiple-choice items, special care must be taken to avoid the double negative. To the examination writer, a combination of negatives in the

stem and in the choices may not be especially troublesome. The students, however, are likely to be confused by an item containing a double negative. As can be seen from the two examples below, a positively stated item is much clearer than an item containing a double negative.

(Poor)

In order to help a patient adjust to unfamiliar surroundings, what should a health worker *not* do?

1) The health worker should not make the patient feel secure by recognizing his needs.
2) The health worker should not become overly familiar with the patient and put him at ease.
3) The health worker should not engage in an extended conversation with the patient about personal matters.
4) The health worker should not delay treatments until the patient has adjusted to his surroundings.

(Improved)

In order to help a patient adjust to unfamiliar surroundings, a health worker should

1) make the patient feel secure by recognizing his needs
2) become very familiar with the patient and put him at ease
3) engage in an extended conversation with the patient about personal matters
4) delay treatments until the patient has adjusted to his surroundings

f. Avoid extraneous clues.

The teacher must be careful to avoid extraneous clues that would help students to choose the correct answer or eliminate an incorrect choice. Students' scores on a test will be a less accurate measure of what they have achieved if an extraneous clue helps them to choose the correct answer or eliminate an incorrect choice. Such clues may assume a variety of forms:

- If the keywords are found in both the stem of an item and one of the choices, that choice is usually the correct answer.
- If one choice is unusually longer than the other choices, that choice is usually the correct answer.
- If a choice is not grammatically consistent with the stem of an item, that choice is usually not the correct answer.
- The choice "none of these" should be used with caution. If the choice "none of these" is used, it should be used in several

items that are grouped together and it should occasionally be the correct answer. In many classroom tests, however, "none of these" is used only because the teacher cannot think of a good fourth choice, and it is rarely the correct answer. Once students realize that "none of these" is rarely the correct answer, they will automatically eliminate it for a reason not related to the concept being tested.

3. Matching Items

a. Each matching question should contain homogeneous premises and homogeneous responses.

The basic problem in preparing matching questions is to write a question that has homogeneous premises and homogeneous responses. If a matching question contains homogeneous premises and homogeneous responses, it will be possible to (1) prepare directions that clearly explain the basis upon which the items are to be matched, and (2) eliminate all extraneous clues that would enable students without the proper knowledge of subject matter to make correct matches. An example of a matching question that does *not* have homogeneous premises and responses is given below.

(Poor)

Match the term in column A with the phrase in column B with which it is most closely associated.

Column A	*Column B*
——*a* head nurse	1) answers the telephone, relays messages, and orders supplies
——*b* urinary system	2) the process used to kill all microorganisms
——*c* disinfection	3) filters liquid waste products from the blood
——*d* ward clerk	4) supervises an entire ward
——*e* circulatory system	5) the process used to kill some, but not all microorganisms
	6) carries oxygen and food to the body's cells
	7) provides the basic daily care for the more chronically ill patients

The best way to determine if a matching question contains homogeneous premises and homogeneous responses is to ask yourself the following question: "Can I with one or two words, or a short

phrase, specifically describe what is contained in each column?" If the answer is *no*, the matching question does not contain homogeneous premises and homogeneous responses. For example, in the question above, column A contains the names of two types of health workers (a, d), two types of body systems (b, e), and one type of sterilization process (c). Column B contains three phrases that describe the duties of health workers (1, 4, 7), two phrases that describe the process of sterilization (2, 5), and two phrases that describe the functions of body systems (3, 6). Since the question given above does not contain homogeneous premises or homogeneous responses, it is impossible to prepare a set of directions that gives the basis upon which the items are to be matched, and it is also impossible to eliminate extraneous clues. The matching question above actually contains the basis for three questions--one on types of health workers, one on types of body systems, and one on types of sterilization processes. The "improved" question below was developed from the section on types of body systems.

(Improved)

On the line at the left of each body function described in parts *a* through *e*, write the number of the body system, chosen from the list below, that performs that function.

Body Systems

1) musculo-skeletal	5) respiratory
2) circulatory	6) endocrine
3) urinary	7) reproductive
4) digestive	8) nervous

——*a* carries oxygen and food to the body's cells
——*b* controls and coordinates all parts of the body
——*c* takes oxygen into the body and removes carbon dioxide from the body
——*d* filters liquid waste products from the blood
——*e* produces chemicals that regulate the body organs

b. Keep the lists of premises and responses relatively short.

The matching lists should be kept short so that they can be easily handled by students. Some matching questions in school examinations have as many as 20 or 30 items in each list. If the students are to compare each of 30 premises with each of 30 responses, they are required to make a total of 30 × 30, or 900 comparisons. Obviously, this is too long and tedious a task to impose upon them. Economy of testing time, generally a strong advantage of the matching question, is no longer achieved.

There are other disadvantages as well. The strong possibility that students may overlook the correct answer because it is buried in a mass of other responses tends to reduce validity. From the teacher's point of view, it is difficult to maintain homogeneity in a long list of items. Further, a long list of matching items usually means excessive concentration on one aspect of achievement, and this prevents proper distribution of emphasis on other aspects.

A popular size in teacher examinations is the 10-item matching unit, which seems to work fairly well. Probably the optimum size from the testing viewpoint, however, would be the matching question containing 5 to 8 items.

c. Provide for extra responses to reduce guessing.

One of the advantages of the matching question is that it tends to minimize the guessing factor. For example, in a matching question with 7 items and 10 responses, the students' chance of guessing the right responses is rather small. In many examinations, however, the practice is to offer a list of premises and a list of responses of equal size. In a matching question with 10 items and 10 responses, if a student knows 8 items of the 10, the chance of guessing correctly the responses to each of the remaining 2 items becomes 1 out of 2. If the student knows 9 of the 10, he or she can answer the remaining item correctly by a process of elimination. It is therefore generally considered good practice to have the number of responses exceed the number of premises. If there are 5 items, 7 responses might be offered. If there are 7 items, 10 responses might be offered.

D. Measuring Achievement to Assign Grades: Psychomotor Domain

1. Introduction

As mentioned previously, student progress toward the achievement of the psychomotor objectives should be measured by performance tests. A performance test involves the careful and systematic observation and evaluation of either the procedures executed by students when performing a job (process evaluation), the product produced by these procedures (product evaluation), or a combination of the two.

When evaluating the procedures involved in student performance (process evaluation), the teacher must observe each student individually. Although this can be a time-consuming task, it is an effec-

tive way for the teacher to assess a student's ability to perform certain procedures. If, for example, a nurse's assisting student were asked to strip a hospital bed, and the teacher evaluated only the product that resulted from this job—the stripped bed—it would be impossible to determine how safely, sanitarily, and efficiently the student had performed that job. In such instances, the teacher must actually observe each student's performance to determine whether the student has satisfactorily performed these procedures.

Some situations may arise in which a student's product can be evaluated (product evaluation) without observation of the individual student. In a dental assisting program, for example, the teacher can effectively evaluate the completed dental-study models that have been produced by the students, so that observation of the individual student is not necessary. In this case, product evaluation is more efficient than the evaluation of the model-making process, because it is less time consuming and it can be done after class time.

When evaluating procedures or a product, the teacher may use either a checklist, a rating scale, or both. A checklist should be used when a teacher is mainly concerned with whether certain procedures are or are not performed (checklist of procedures) or whether certain product characteristics are present or not present (checklist of product characteristics). A rating scale should be used when the teacher wants to evaluate how well certain procedures are performed (rating of procedures), or the degree to which certain characteristics are present in the product (rating of product characteristics).

Checklists consist of a vertical listing of either the characteristics of a product or a series of procedures. The procedures should be listed in the order of occurrence. For each item listed, the observer indicates with a checkmark or a yes-no response whether or not the required behavior had occurred or the required characteristic was present. The raw score should equal the total number of checkmarks or the total number of "yes" answers.

Rating scales also consist of a vertical listing of the characteristics of a product or a series of procedures. In a rating scale, however, a continuum of merit or quality is established for each item listed. The continuum is usually divided into three to five positions which are listed horizontally. Each position is identified by a number and represents a certain degree of merit or quality. The observer then rates each item by choosing the position that corresponds most closely to the degree of merit or quality observed. When the rating scale is scored, the raw score equals the sum of the ratings for all of the items on the rating scale.

2. Procedures for Construction of a Performance Test

When a teacher develops a performance test for a specific objective, he or she should first list all procedures that the students are expected to perform and then list the supplies and equipment that the students are expected to use in accomplishing that objective. The teacher can then prepare an exercise that requires the students to perform the procedures and use the supplies and equipment listed. Production of a particular product may be designated as a part of the exercise, if the teacher so desires.

The next step is to decide which procedures and/or characteristics of the product are to be evaluated. The teacher should now prepare the checklist and/or rating scale that will be used to evaluate the selected procedures and/or characteristics of the product.

The following is a sample psychomotor (behavioral) objective that can be evaluated by means of a performance test. This objective will be used to illustrate the steps outlined above for constructing performance tests.

It should be noted that in the example, one checklist and a five-point rating scale are used to evaluate student performance. Because of the difference in methods of recording ratings, the raw scores for each method must be converted before they can be combined to obtain a total score for the performance test. The method used to convert the raw scores is explained in the sample below. After the scores have been converted, they can be added together to give a total score for the performance test. The student should attain a total score of at least 75 percent, as is stated in the behavioral objective.

3. Sample Performance Test Exercise

a. Behavioral Objective

Given a patient whose blood pressure is to be recorded, the student will be able to obtain a score of at least 75 percent on a performance test exercise that requires the student to select the necessary equipment and supplies, take the patient's blood pressure, and record the results.

b. List of Procedures

1. The student identifies the patient and explains the procedure.
2. The student obtains the appropriate equipment.
3. The student cleans the earpieces of the stethoscope.
4. The student positions the patient correctly.

5. The student places the cuff 2 inches above elbow (approximate heart level).
6. The student places the stethoscope over brachial artery.
7. The student inflates cuff to a minimum of 180 mm of mercury.
8. The student deflates the cuff slowly.
9. The student reads mercury column and listens to pulse sounds.
10. The student repeats process (to check recording).
11. The student removes equipment from patient's arm.
12. The student records findings on patient's chart.
13. The student works efficiently with the equipment being used.
14. The student has good rapport with the patient being tested.
15. The student carries out procedures in proper sequence.

c. List of Equipment and Supplies

alcohol sponges	wastepaper bag
stethoscope	pencil and paper (patient's chart)
sphygmomanometer	

d. Performance Test Exercise

Using another student as the patient, and following the procedures discussed in class, select the appropriate equipment and supplies, take the patient's blood pressure, and record the results.

e. Evaluation of Performance

• Process Evaluation

For the process evaluation of the above behavioral objective, two techniques will be used: a checklist and a rating scale.

Checklist of Procedures

	Performed no = 0 yes = 1
1. The student identified the patient and explained the procedure.	
2. The student obtained the appropriate equipment.	
3. The student cleaned the earpieces of the stethoscope.	
4. The student positioned the patient correctly.	
5. The student placed the cuff 2 inches above elbow (approximate heart level).	
6. The student placed the stethoscope over brachial artery.	
7. The student inflated the cuff to a minimum of 180 mm of mercury.	
8. The student deflated the cuff slowly.	
9. The student read mercury column and listened to pulse sounds.	
10. The student repeated process (to check recording).	
11. The student removed equipment from patient's arm.	
12. The student recorded findings on patient's chart.	

(maximum raw score = 12) raw score = _____

$$\text{converted score} = \frac{\text{raw score}^*}{1}$$

* In each case, the converted score equals the raw score divided by the maximum number of points the student can obtain on an item for that evaluation technique.

Rating of Procedures

	never —1—	seldom —2—	some-times —3—	usually —4—	always —5—
1. Works efficiently with equipment					
2. Has good rapport with patient					
3. Carries out procedures in proper sequence					

(maximum raw score = 15) raw score = _____

$$\text{converted score} = \frac{\text{raw score}^*}{5}$$

*In each case, the converted score equals the raw score divided by the maximum number of points the student can obtain on an item for that evaluation technique.

III. PREPARING INSTRUMENTS USED TO EVALUATE AND PLAN INSTRUCTION

A. Evaluating and Planning Instruction: Cognitive Domain

Section II-C of this booklet contains suggestions for preparing test items that can be used to measure student achievement of the cognitive objectives for the purpose of assigning grades. These same test items also can be used by the teacher to evaluate and plan instruction. For example, if several students receive poor test scores on items that test their knowledge of certain facts or their understanding of certain concepts, the teacher may decide that these facts or concepts need reteaching and may plan further instruction accordingly.

At other times, the teacher may wish to measure students' achievement of the cognitive objectives solely for the purpose of planning instruction. For example, the teacher may adminster a group of test items prior to instruction in order to determine how far students have progressed toward achieving certain cognitive objectives. The test results would then be used only to plan the most appropriate instructional program for these students.

Thus, the same test items and test results that are used to assign student grades also can be used to evaluate and plan instruction—only the intended purpose would change.

B. Evaluating and Planning Instruction: Psychomotor Domain

Section II-D of this booklet contains suggestions for preparing performance tests that can be used to measure student achievement of the psychomotor objectives for the purpose of assigning grades. The same performance tests can be used by the teacher to evaluate and plan instruction. For example, if several students obtain poor scores on the performance of certain skills, the teacher may decide that these students need additional practice in order to obtain mastery of these skills and may plan instruction accordingly.

The teacher may decide to have the students rate each others' performance. These peer ratings could not be used to assign student grades because of potential bias and unreliability, but the results

may be reliable enough to be used to evaluate and plan instruction. Indirectly, another objective may be achieved: in rating their peers, the students may become more keenly aware of the procedures and criteria, and thus enhance their own acquisition of the observed skills.

The teacher may also decide to have the students rate their own performance. Again the results would not be reliable enough to use for assigning grades, but as a result of this self-evaluation, the student and teacher may plan future instructional experiences appropriate to the individual students needs.

Thus, the same performance tests that are used to assign student grades can also be used to evaluate and plan instruction—only the intended use would be changed. Whenever students are rating themselves or each other, the teacher should be sure to inform them that the test results are *not* being used to assign grades. This will help to insure that their ratings will be a reliable indication of student performance.

Two examples of performance tests that could be used to plan and evaluate instruction are shown below. These performance tests were prepared according to the procedures discussed in Section II-D. It should be noted that since the second example was designed as a self-inventory, the statements to be rated were phrased in the first person.

Directions: Check the column that best describes the way that the student demonstrates toothbrushing technique.

	never —1—	some-times —2—	always —3—
1. Speaks with expression			
2. Speaks distinctly			
3. Maintains child's (children's) attention			
4. Holds toothbrush and dental model so that the child (children) can see			
5. Looks at the child (children) while speaking			
6. Demonstrates appropriate techniques			
7. Provides time for questions and discussion			
		total score	

(total possible points = 21 points)

Rating:

17–21 points—excellent
12–16 points—fair
7–11 points—poor

(*Note:* This rating scale may be scored by the teacher, another observer, or another student.)

Staff Relationships: A Self-Inventory

Directions: Rate yourself from 1 to 5 to describe what you do to function responsibly and cooperatively as a member of the health-care team. Results may be used to help you improve your performance.

	never —1—	seldom —2—	some-times —3—	usually —4—	always —5—
1. I address all staff members by their last names and use the proper titles—Doctor, Mr., Miss, Mrs.					
2. I report to the supervisor in charge whenever I leave the unit for any purpose and when I return					
3. I listen carefully to instructions given to me by the supervisor in charge					
4. If I am confused about any assignments, I ask the supervisor in charge for interpretation					
5. I do an assigned task quickly, quietly, and efficiently					
6. Within my responsibility I perform, without being told, tasks I know should be done					
7. I am considerate and tactful with other team members					
				total score	

(total possible score = 35)

Self-Rating:

25–35 points—very good team member

15–24 points—need some improvement

8–14 points—need very much improvement

C. Evaluating and Planning Instruction: Affective Domain

1. Introduction

As mentioned previously, the courses of study in Health Occupation Education contain affective objectives that involve ". . . changes in interests, attitudes and values, and the development of appreciations and adequate adjustments."[4] When planning and evaluating instruction, the teacher should measure students' growth relative to the affective objectives as well as the cognitive and psychomotor outcomes.

Some of the instruments that may be used to measure student achievement of the affective objectives are questionnaires, inventories, logs, diaries, and anecdotal records. The validity and reliability of the information obtained by these instruments is closely related to the quality of the instruments themselves. Poorly constructed instruments are likely to produce inaccurate results; therefore, it is important that these instruments be as well constructed as possible. The following sections contain a brief discussion of the uses and limitations of each type of instrument, guidelines that should be followed when constructing each type of instrument, and illustrative examples.

2. Questionnaires and Inventories

a. Use of Questionnaires and Inventories

The use of questionnaires and inventories should be limited to situations where the desired information cannot be obtained more easily in another manner, such as by an interview. Questionnaires and inventories are used to gather information about the interests, needs, concerns, opinions, and judgments of students as well as to obtain factual information about students' backgrounds, family, and home conditions. They may be used to obtain information about students from not only the students themselves, but also from the students' peers, parents, and other adults.

b. Limitations of Questionnaires and Inventories

Whenever interpretating the information obtained by questionnaires and inventories, the teacher should remember that this information may be subject to some unreliability (inconsistent re-

[4]Bloom, op. cit., p. 3

sponses upon retesting at later times). This unreliability is due to the fact that students' interests, attitudes, and values are constantly changing, particularly at the junior and senior high school level.

Other factors that may cause the information obtained by these instruments to be unreliable are the respondents' degree of awareness of their own attitudes, interests, opinions, or knowledge, their ability to verbalize them, and the respondents' willingness to tell the truth. The respondent's willingness to tell the truth can be increased by instructing them, whenever possible, to respond anonymously. This practice will help to encourage the students to answer more frankly and will enable the teacher to plan instruction more accurately.

c. Guidelines for Preparing Questionnaires and Inventories

The formats of questionnaires and inventories differ somewhat. Questionnaires usually ask respondents to provide information in several related areas. The respondents may be asked to provide the information by checking the correct answer to a question, or by writing one or two words, a short sentence, or even a paragraph. An inventory usually covers only one area of consideration, and the respondents provide the requested information by checking their answer to the question being asked. The guidelines given below should be followed in the construction of questionnaires and inventories:

- Clearly define the purposes of questionnaires and inventories so that all necessary items will be included and all unnecessary items excluded.
- Limit the total length of questionnaires and inventories and the length of each item to insure that the students will carefully answer each item.
- Use understandable vocabulary.
- Limit each item to one area of consideration to help avoid difficulty in interpreting responses.
- Provide sufficient response categories to include all possible responses.
- Include "cross-checking" questions to determine consistency of responses.
- Group together questions that deal with the same area. Within each area, group together questions that use the same type of response format (true-false, multiple-choice, fill-in-the-blank, etc.).
- Design the format attractively (well spaced, well printed) to motivate the respondent to completely answer all questions.

- Design the groupings and response categories so as to provide easy summary and interpretation of results.

d. Examples of a Questionnaire and an Inventory

The following are examples of a questionnaire and an inventory:

Questionnaire—Clinical/Work Experience Assignments

Name: _____

Date: _____

1. List the various tasks you have performed during your clinical/work experience.

2. Of the tasks you listed above, which ones do you feel you are able to perform properly and efficiently?

3. List the aspects of your clinical/work experience that you enjoyed the most.

4. To what extent do the following describe your impression of the clinical/work experience situation?

	Seldom	Usually	Always
a. The patient/client is the first concern			
b. The staff works well together ...			
c. Staff members are considerate and tactful with each other			
d. Staff members are helpful to each other			
e. Staff members use their time well			
f. As a student in training, I am given help and understanding by staff members			

Health Occupations Interest Inventory

Directions: The purpose of this inventory is to determine your interests in various health occupations so that appropriate learning activities may be planned. Check the column that best describes your level of interest.

Are you interested in the position?	very interested	somewhat interested	not at all interested
1. Biomedical Equipment Technician			
2. Cytotechnologist			
3. Dental Assistant			
4. Dental Hygienist			
5. Dental Laboratory Technician			
6. Dietetic Technician			
7. Electroencephalographic Technician			
8. Environmental Health Technician			
9. Histologic Technician			
10. Inhalation Therapy Technician			
11. Medical Assistant			
12. Medical Laboratory Personnel			
13. Medical or Dental Secretary			
14. Medical Record Technician			
15. Mental Health Technician			
16. Occupational Therapy Assistant			
17. Operating Room Technician			
18. Optician			
19. Optometric Technician			
20. Orthoptist			
21. Physical Therapy Assistant			
22. Practical Nurse			
23. Prosthetist and Orthoptist			
24. Radiologic Technician			
25. Registered Nurse			
26. Other (specify)			

3. Logs and Diaries

a. Uses of Logs and Diaries

Teachers and students can use logs and diaries to record information about student activities, needs, feelings, and attitudes that cannot be obtained by the more objective test procedures. The information recorded in logs and diaries can be used as a basis for evaluating student achievement of the affective outcomes and for planning future instruction. The same information can also serve as a basis for discussion during teacher-student conferences and classroom instruction.

There is no sharp distinction between logs and diaries. The same type of behavior can be recorded in both. The main difference is that in a log, recordings are made only when the behavior being observed occurs, whereas in a diary, recordings are made on a daily basis over a certain period of time.

Logs and diaries are especially effective for recording observations made during clinical laboratory demonstrations, supervised clinical work experience, and during observation visits to health-care institutions. Through recording pertinent information in logs and diaries, the student can sharpen observing and reporting skills by writing exactly what is observed.

Both logs and diaries can be used to record information about interpersonal relationships that may provide students with insight into their own attitudes and behavior in getting along with patients and staff.

The information recorded in logs and diaries should reflect concern for personal privacy of patients and also an appreciation of professional ethics and behavior.

b. Limitations of Logs and Diaries

The information recorded in logs and diaries may be influenced by several factors. A major limitation is that students may not wish to keep a revealing account of personal feelings and data. In fact, those students who need help the most are the ones least likely to record personal feelings or data. Also, a recording can easily be biased by the mood that students are in while making the recording. A happy student and a depressed student could make two entirely different recordings of the same observation. The information recorded in logs and diaries may also be influenced by the degree of insight that students have into their behavior and their ability to document it.

c. Guidelines for Constructing Logs and Diaries

The guidelines below should be followed when logs and diaries are constructed.

- Determine the purpose of the log or diary, i.e., how will the information recorded in the log or diary be used by the student or teacher? For example, a teacher could use the information recorded in a log or diary to help students to:
  —become aware of how well they make use of time
  —become aware of their values, attitudes, and appreciations
  —learn why some patients behave as they do
  —evaluate their responsibilities on the health-care team
  —evaluate their interpersonal relationships with patients and staff
- After the purpose of the log or diary has been determined, the teacher and student must next decide which specific information must be recorded by the students in order for the log or diary to serve its intended purpose.
- The teacher should now assist students in listing exactly what type of information should be recorded. This will insure that relevant information will be included and most irrelevant information excluded.
- Students should be instructed to record information about an event either during or immediately after it occurs. The longer the students wait to make their recordings, the less accurate the recordings will be.

d. Examples of a Log or Diary

Log: Nursing Home Observation

Purpose: To observe and record characteristics and behaviors of elderly patients in order to be able to recognize characteristics of the natural aging process.

Directions: As assigned at the nursing home, use the Observation Log to record your observations of elderly patients.

Record all characteristics and behaviors that you feel are a result of the natural aging process. Add any comments that you might wish to make.

Observation Log

Name of Observer: _____

Nursing Home: _____

Date, Time, and Setting of Observation	Characteristics and Behaviors Observed	Comments

Diary: Nurse's Aide Skills

Purpose: To record the skills you perform at the nursing home for one week to determine the type and frequency of these skills.

Directions: For one week, keep a diary of the nursing skills that you perform each day. At the end of the week, indicate the types of skills performed, total the frequencies for each skill, and indicate the total number of tasks performed.

Monday

_____

_____

_____

Tuesday

_____

_____

_____

Wednesday

_____

_____

_____

Thursday

_____

_____

_____

Friday

_____

_____

_____

Saturday

_____

_____

_____

Sunday

_____

_____

_____

Type of Skill	Frequency
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Total Number of Skills _____

(*Note:* On an actual form, more space should be provided for daily records.)

4. Anecdotal Records

a. Use of Anecdotal Records

Anecdotal records are factual reports of exactly what a person said or did in certain situations. Anecdotal records should be limited to the areas of social, personal, and emotional adjustment and growth. Data on physical status, academic achievement, and study skills can be obtained more efficiently by other methods. Observations in these areas should be included in anecdotal records only when the observations might have a marked effect on a student's personality.

An anecdotal record is usually assembled over a long period of time. It helps the teacher to gain an understanding of a student's personality needs. Once the teacher has gained this understanding, the teacher is better able to plan instruction and develop a classroom atmosphere that will help the student to develop a healthy personality.

Anecdotal records can serve as a basis for individual conferences with students and parents. They may also serve as a cross-check on a student's recordings in a log or diary.

b. Limitations of Anecdotal Records

One limitation of anecdotal records is the time required to prepare them. For this reason, a teacher using anecdotal records usually studies only two or three students at one time.

A second limitation of anecdotal records is that they may be based upon inaccurate observations. Many people have the tendency to see or hear what they expect, rather than what may actually occur. In addition, the incident being observed may not always be recorded objectively. Many people find it difficult to record a purely factual account of an incident. They tend to inject their opinions and feelings into the recording without labeling them as such.

Another limitation of anecdotal records is that they may not contain an adequate sampling of student behavior. A student's record may contain summaries of mainly favorable or unfavorable incidents, which could lead to an invalid conclusion about a student's behavior or personality.

c. Guidelines for Preparing and Using Anecdotal Records

The guidelines given below should be followed when preparing and using anecdotal records.

- Study a limited number of students at one time. This will help to keep the teacher from being swamped by a mass of detailed observations.

- Record only those incidents that will contribute significantly to the solution of the problem being studied. If there is any question whether an incident is significant or not, the teacher should record the incident and then discard it later if it is found to be unrelated to the problem being studied.
- Record both favorable and unfavorable incidents that are significant. A true picture of a student's behavior will not emerge if only favorable or unfavorable incidents are recorded.
- Record incidents both in and out of class. Each student should be observed in as many different situations and activities as possible so that a representative sampling of the student's behavior is obtained.
- Record each incident as soon after it occurs as possible. The longer a teacher waits to make a report, the more distorted the report will tend to be.
- Each report should contain some statement of the situation in which the incident occurred so that the report can be properly interpreted at a later date.
- Each report should be as brief and objective as possible. The teacher should not include personal reactions and interpretations in the factual report of the incident. If the teacher wishes to include an interpretation or recommendations for the specific incident, these should be recorded separately and labeled as such.
- Generalizations and judgments about student behavior should not be made until a fairly large number of reports are available. An erroneous picture of student behavior may result if generalizations and judgments are based on limited information.
- Record the report of each incident on a separate index card. The following information should be recorded for each incident:
  — name of student
  — name of observer
  — date of observation
  — setting or background of incident
  — factual report of incident
  — interpretation of incident and recommendations (optional)

d. Examples of an Anecdotal Report Form

Anecdotal Record Form

Name of Student _____

School _____ Grade ____

Date of Observation _____

Observer's Signature _____

Setting:

Incident:

(front of index card)

Interpretation:

Recommendations:

(reverse side of index card)

(*Note:* Additional cards may be used for multiple anecdotal records.)

Selected References

Almann, J. Stanley and Marvin D. Glock. *Evaluating Pupil Growth*. Boston: Allyn and Bacon, Inc., 1971.

Bloom, Benjamin S., ed. *Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain*. New York: David McKay Company, Inc., 1956.

Greene, Harry A., Albert N. Jorgensen, and J. Raymond Gerberich. *Measurement and Evaluation in the Elementary School*. New York: Longmans, Green and Co., 1953.

Schwartz, Alfred, Stuart G. Tudeman, and Donald G. Wallace. *Evaluating Student Progress in the Secondary School*. New York: Longmans, Green and Co., 1957.

Thorndike, Robert L., ed. *Educational Measurement*. Washington, D.C.: American Council on Education, 1971.

Tinkelman, Sherman N. *Improving the Classroom Test, A Manual of Test Construction for the Classroom Teacher*. Albany, New York: State Education Department, 1968.

Wrightstone, J. Wayne, Joseph Justman, and Irving Robbins. *Evaluation in Modern Education*. New York: American Book Company, 1956.